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SHORT COMMUNICATION

Catheter-induced dissection of a normal right coronary artery: Reappraisal of the underlying mechanisms

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Abstract Iatrogenic coronary artery dissection during diagnostic coronary catheterization is a rare but life-threatening event with a reported incidence of less than 0.1%. The current case report addresses the issue of catheter-induced dissection of an apparently normal right coronary artery (RCA). I tried to explain the factors underlying its occurrence, in view of the current knowledge of the aortic root motion during the cardiac cycle, and the spatial orientation of the RCA ostium.

1. Introduction

Iatrogenic coronary artery dissection during diagnostic coronary catheterization is a rare but life-threatening event with a reported incidence of less than 0.1%.[1] It results from mechanical injury to the arterial wall during catheter or wire manipulation, passage or deployment of an interventional device, forceful injection of contrast medium, or balloon dilatation or stenting.[2] Patients with ostial coronary artery stenosis, hypertension, Marfan syndrome, congenitally unicuspid and bicuspid aortic valves, and cystic medial necrosis have been reported to be at higher risk of dissection.[3]

2. Case presentation

A female patient 52 years old, obese, hypertensive, dyslipidemic and not diabetic, presented to our clinic with repetitive episodes of typical retrosternal chest pain since 2 years, to some extent the pain was exertional and in same location, relieved with rest and nitro-glycerine. Resting ECG showed non specific T waves inversion in inferior leads. Resting Echo was quite normal, and blood samples were taken for CBC, Lipid profile, FBS, renal functions and coagulation profile. Stress ECG showed subtle ST segment depression in infero-lateral leads in the 3rd stage when patient developed chest pain.

Decision making was in favor of doing coronary angiography as other diagnostic modalities for example CT-coronary angiography was not available in our locality. Femoral approach was chosen as there were no available Radial sets. Left coronary system was cannulated by JL4, 6F Catheter, and there were no lesions. RCA was cannulated by JR 3.5,

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6F Catheter, there was no forceful manipulation of the catheter and an easy cannulation was done.

Catheter induced dissection of the proximal RCA was accidentally committed, and trials of non-selective cannulation were done and revealed no ostial lesions. The patient suddenly complained of severe chest pain. There was ST-segment elevation in the inferior leads of the electrocardiogram (ECG). Rapid measures were prepared to fix that dissection before spreading retrograde into the ascending aorta 10,000 units of unfractionated heparin plus 8 * 75 mg Clopidogrel was loaded, JR 4, 6F GC was used, BMW floppy wire was successfully crossed to the distal end of the RCA, pre-dilatation was done by using 2.0 * 20 mm Maverick Balloon, dissected segment was about more than 30 mm long with a proximal inlet and distally sited exit just before distal bifurcation of RCA, the inlet segment was fixed by 3.5 * 28 mm BMS deployed at 14 atm, while the exit was fixed by 2.75 * 24 mm BMS deployed at 12 atm, with nicely restoration of TIMI III flow and myocardial blush grade III (Fig. 1). The patient's chest pain was resolved and ECG changes improved. There was no post-procedural cardiac enzyme elevation and the patient discharged the following day.

3. Discussion

Several studies tried to show whether there is any anatomical and histological background of the catheter induced dissections, in a study done by José et al.[4] where they studied the structural features of the sinus of valsalva and the proximal portion of the coronary arteries and their role in the pathogenesis of aorto-coronary dissections they found:

1. The angle that the left coronary artery forms with the ascending aorta is acute (range, 20–55°) and that of the right coronary artery tends to be straight (range, 60–88°). This means that the aorto-coronary junction and the proximal course of the left coronary artery can provide a better approach for catheterization than the right coronary artery, due to their coaxial alignment in relation to the ascending aorta.
2. The diameter of the ostium of the left coronary artery was larger than that of the right in 76% of their cases.
3. Histologically, the left coronary artery has a greater number of smooth muscle cells set in large amounts of type I collagen. It is well-known that type I collagen, in contrast to type III, has greater tensile strength, which could mean that the right coronary artery ostium is less resistant to traction and, as a result, could more easily give rise to retrogressive aortic dissection as a complication of coronary intervention.[4]

On midline search few studies had mentioned the aortic root deformation but none of those had mention the role of aortic root deformation dynamics in the pathogenesis of aorto-coronary dissections. Several studies applying cinematography and contrast injections have visualized aortic root motion wherein the root is displaced downward during systole and returns to its previous position in diastole.[5] Recent cine-MRI studies in healthy subjects revealed an axial downward motion of 8.9 mm and a clockwise axial twist of 6 degrees during systole.[6] The force driving the aortic annulus motion is the ventricular traction accompanying every heart beat. This force is transmitted to the aortic root, the ascending aorta, the transverse aortic arch, and the supra-aortic vessels.[7] Thus, the aortic

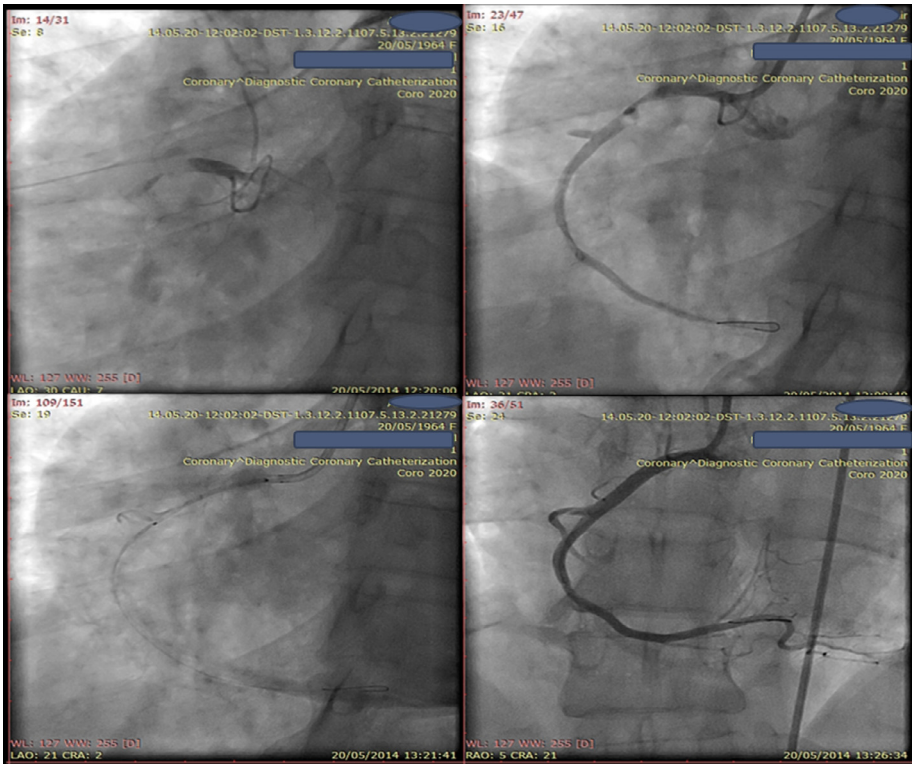

Figure 1 Showing steps of PCI to dissected RCA at proximal inlet and mid to distal exit of the dissected flab by 2 BMS.

root motion has a direct influence on the deformation of the aorta and on the mechanical stress exerted on the aortic wall.

In addition early in vivo dynamic studies of the aortic root showed its significant expansion during the cardiac cycle, but without consideration of the possible asymmetry of each sinus.[8]

Recent dynamic studies with better instrumentation have shown in vivo that this anatomical asymmetry corresponds to a dynamic deformation of the aortic root. Dagum et al.[9] and Emmanuel et al.[10] showed a heterogeneous torsion of the three sinuses of Valsalva that is, one sinus twisting in the opposite direction to the other two. The underlying mechanism and physiological relevance of these findings is unknown. It could be hypothesized that the twist deformation of the aortic root is somehow related to the presence of the coronary Ostia in only two sinuses (and/or dominance in the coronary circulation) because the non-coronary sinus never twisted in opposition to the other two.

So from the previous studies I could understand and also suppose in my case here two kinds of changes or phenomena might happened at the site of aortic root:

- One is dependent on flow dynamics where the reflection wave of the arterial pulse specially in hypertensive patients where atherosclerosis could facilitate rapid reflection of pulse wave back to the aortic root where it could make rapid vortex flow of blood at the sinuses of valsalva and that could make attraction of the catheter into the coronary artery.
- Second is dependent of motion dynamics of the aortic root where in hypertensive patients there are increased shear stresses on aortic root walls which make it relatively movable structure that may affect the position of the catheter while it is engaged inside the coronary artery predisposing to dissection.

Finally as had been mentioned in a study done on Egyptian women[11] authors concluded that better attention is advised to be given to women with chest pain to exclude CAD by non-invasive testing and include proper medical therapy before referral to invasive coronary procedures. The high success rate of coronary interventional procedures among females encourages referral of patients suspected to have CAD with better precautions to avoid noticeably higher complications.

4. Conclusion

In hypertensive patients there might be two phenomena at the aortic root: one is flow dependent and the other is wall motion dependent both could affect the cannulation of the coronary Ostia and may accidentally facilitate the occurrence of coronary dissection.

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Conflict of interest

No conflict of interest.

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